



ROAD TRANSPORT MANAGEMENT AND INNOVATIONS

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Abstract: In these times of progressing globalization, pursuit of development and undertaking new challenges for enterprises, the constant improvement of road transport is significant. The subject matter of the herein paper is to illustrate the fact that road transport is one of the most important factors determining the economic growth of the country, while also being an indispensable element of everyday life. This paper is based on empirical deliberations relating to the functions and role of transport for society as a whole by referring to the significant issues of road transport in the logistics chains. The aim of the theoretical research is to indicate the new directions of the development of logistics and innovations applied in transport.

Keywords: management, transport, logistics, innovations

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Introduction

Road transport plays a significant role in the correct functioning of the social and economic spheres of the country. In the contemporary world, it is a level of economic activity that ensures the efficient functioning of the logistics systems in each area of the economy. Transport may be acknowledged to be one of the key determinants of the development of the economy and society itself.

Contemporary development trends, internationalization and globalization pose increasingly greater requirements to transport. The development of transport is simultaneously a factor in the economic growth of regions and countries, without which this development could not take place.

The need to create and implement new concepts of management and innovations in transport results from the constantly low level of efficiency of multiple technical and organizational elements existing in the processes, which is visible in terms of the insufficient level of efficiency, capacity, reliability, occurrence of losses of time and resources, while also overpricing of the business costs. The motive behind the search for innovative solutions in road management is the improvement of the

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economic and environmental ties, while also restricting the negative consequences for the environs. The appropriate processes of road management are required with the aim of fulfilling the function of the development of society (Burnewicz 2010, p. 52).

Significance of transport in economy

Together with the changes occurring in the economy, the functioning of transport is also undergoing an evolution all the time. In the period of the globalization of the contemporary economy a dense network of transportation connections is necessary, which facilitates the market participants, namely, producers, exporters and importers, to enter contracts freely regardless of where the goods are located and where the potential purchaser of the product is located (Neider 2008, p. 5).

Transport in the domestic economy may be viewed as a supplier and as a client. As a supplier it facilitates the exchange of goods, while being applied for the transportation of raw materials, materials and semi-finished products, while also finished goods. Transport is thus the continuation of production in the sphere of trade as the final phase of the broadly understood manufacturing cycle. However, the client is served by the remaining branches of the economy (Burnewicz 2010). Transport can not exist without fuel and electric power, thus in this way it is dependent on the primary industry, chemical industry and production of electric power (Hajdul et al. 2015, p. 12).

In subject-related literature there is a multitude of definitions of transport. First and foremost transport relates to the movement of people and objects. In accordance with the fact that we only deal with transport when the action of movement is utilized with relation to specific items or people, we organize the necessary technological process of movement and utilize the specific means of work for this purpose (Brach 2012, p. 21). These elements create the transportation system, namely, the entirety of the technical and economic issues, while also organizational and legislative issues that exist in the process of mutual cooperation with the particular types of transport, as well as defining the nature of dependency and ties between transport and other sectors of the national economy (Bentkowska-Senator, Kordel, Waśkiewicz 2012, p. 11). Planning in the sphere of the transportation systems in a time horizon refers to the long-term and short-term realization of tasks in strategic and operational aspects. This type of division is a canvas for distinguishing strategic and operational management. Within the framework of the decision-making processes, different variants are considered, particularly with relation to the road infrastructure of the economy as a whole, determining the area of designing and realization of the transportation operations in enterprises (Grigutsch et al. 2014, p. 715).

Transport fulfils specific functions in the domestic economy, which are as follows (Urbanyi-Popiołek 2013, p. 10):

- it is an instrument for the exchange of goods and services, while conditioning the transportation of goods as the subject of trade;
- it is the factor of the growth of GDP and has an impact on the development of other sectors of the domestic economy;

- it conditions the development of the location of production and settlements – the existing and planned transportation network, as well as the fact that its level determines the location of investments, while also being a factor in the urban and regional creativity;
- it realizes the social aims, such as, for example, the fulfilment of the communicative needs of humanity, or the increase of the availability of the sphere of economic life, e.g. culture, education or sport.

Transport may be classified according to various characteristics. By taking account of the herein subject matter, we relate to the criteria of the divisions with regard to the nature of the environment which road transport exists in (Hyard 2013). Road transport is the most frequently utilized branch of transport in terms of land transportation of goods and people. The state and development of road transport in 2017 is illustrated in *Table 1*.

Table 1. Numerical set of means of vehicle transport in Poland broken down into provinces in 2017

| No. | Province | Passenger cars | Heavy goods vehicles | Tractor units |
|-----|---------------------|----------------|----------------------|---------------|
| 1. | Poland in total | 22 503 579 | 3 248 538 | 391 371 |
| 2. | Dolnośląskie | 1 750 185 | 238 071 | 19 386 |
| 3. | Kujawsko-pomorskie | 1 194 256 | 164 359 | 17 176 |
| 4. | Lubelskie | 1 205 507 | 164 147 | 18 060 |
| 5. | Lubuskie | 629 924 | 88 218 | 10 579 |
| 6. | Łódzkie | 1 465 686 | 227 783 | 23 367 |
| 7. | Małopolskie | 1 879 860 | 277 365 | 24 559 |
| 8. | Mazowieckie | 3 491 493 | 564 213 | 95 626 |
| 9. | Opolskie | 619 568 | 74 845 | 8 817 |
| 10. | Podkarpackie | 1 133 396 | 154 414 | 14 298 |
| 11. | Podlaskie | 596 413 | 85 122 | 10 057 |
| 12. | Pomorskie | 1 340 787 | 190 779 | 24 218 |
| 13. | Śląskie | 2 559 013 | 321 455 | 36 592 |
| 14. | Świętokrzyskie | 680 689 | 124 721 | 12 508 |
| 15. | Warmińsko-mazurskie | 751 527 | 101 163 | 9 475 |
| 16. | Wielkopolskie | 2 259 361 | 337 061 | 51 826 |

Source: Self-analysis on the basis of statistical data of 2017, GUS (Central Statistics Office)

The data presented illustrates that the greatest number of passenger cars is at the disposal of the inhabitants in the following provinces: mazowieckie, śląskie, wielkopolskie, małopolskie, dolnośląskie, łódzkie, pomorskie, podkarpackie, lubelskie and kujawsko-pomorskie. In the provinces of podlaskie, lubuskie, opolskie,

świętokrzyskie and warmińskie-mazurskie the number of passenger cars is decidedly lower. Approximate trends are characteristic of provinces in the area of trucks and tractors. The expansion of analysis was conducted within the framework of the type of loads with a division of transport for hire and commercial transport (Table 2). The afore-mentioned data indicates the domination of the bulk cargo loads and loads on pallets. The numerical characteristics illustrate the chosen issues of the functioning of transport in the domestic economy, as well as its location in logistics.

Transport in logistics chains

The activities of transport require a logistic context. The role of logistics in the activities of an enterprise is key. The logistics of enterprises relates to management, moving and stacking products that are meant to facilitate the physical flow of goods, commencing from the place of origin to the final client with the simultaneous flow of information aimed at fulfilling the needs and requirements of the client (Jacyna 2009, p. 54). A layout of the integrated logistics chain is presented in Figure 1.

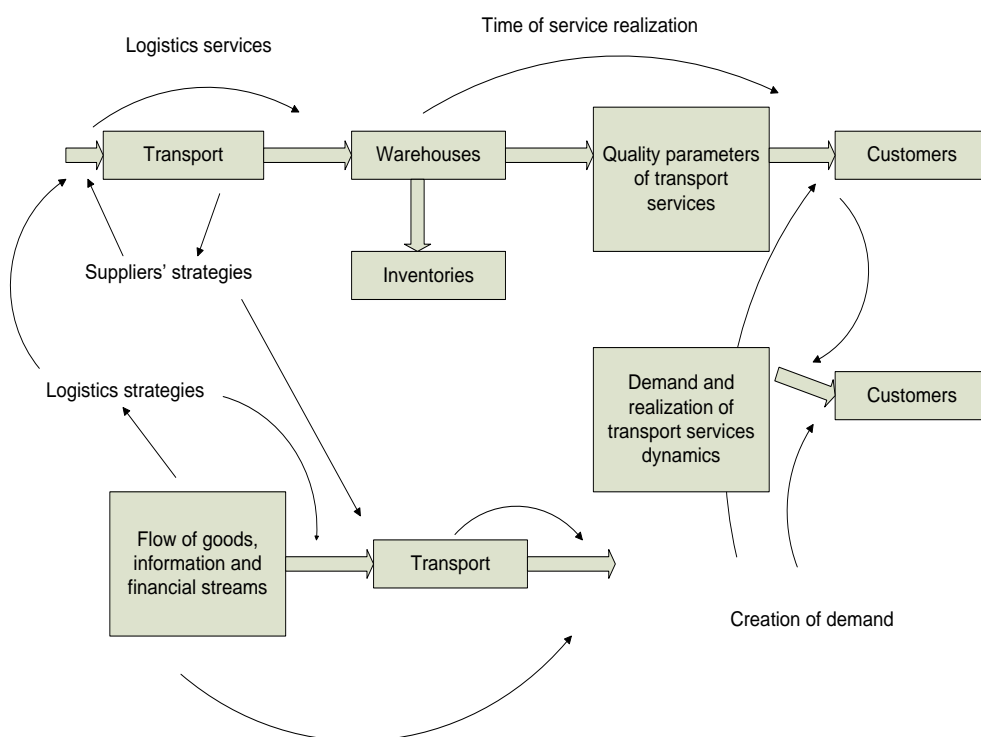


Figure 1. Model of logistics system in the context of dynamics of transportation services

Source: Self-analysis on the basis of (Schäfers, Schmidt 2015, pp. 775-778)

Conducting the multi-criteria assessment of logistics systems and indicating transport management should be aimed at defining the composite elements, which are as follows (Nowicka-Skowron 2000, p. 25):

- a formulated aim;
- systemic entry points;
- an exit which defines the function of the aim;
- process transformation;
- the environment created by business entities, banks, public institutions;
- production potential;
- environmental infrastructure;
- managerial staff.

The particular elements distinguished require analysis in the context of logistics and transport. An important element in the correct functioning of the logistics and transport systems is the building of ties between its particular composite elements. This is illustrated by *Figure 2*.

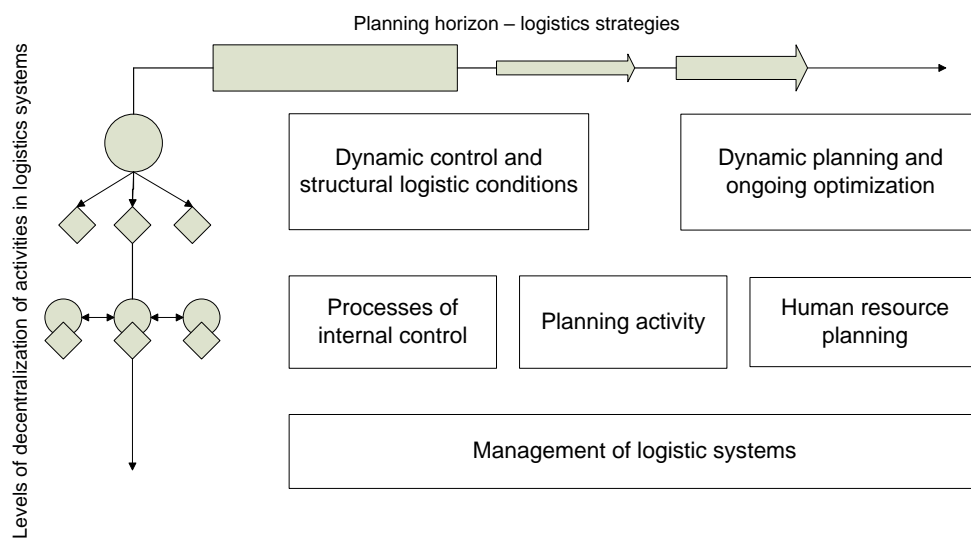


Figure 2. Processes of control in logistics systems

Source: Self-analysis on the basis of (Kersten, Skirde, Lammers 2013, pp. 90-95)

The problem of transport in the logistics network of dependencies is characterized by the transported goods, structure and features of the region supplied, while also the location of the supply and receipt points, while also the type of offer and demand (Woźniak, Kucielka 2011, p. 444). Logistics systems can not exist without an efficiently functioning system of transport. This transport takes place within the framework of the supply chain. The key role of transport in the chain/network causes the fact that the appropriate management of the transfer of materials, semi-finished goods and finished goods between enterprises and their various locations is

significant. The supply chain/network consists of the sequence of the logistics flow, processing of activities associated with service – from suppliers to the final clients, which is necessary for the creation of a product in an effective and efficient manner. The essence of management is concentrated on supplying the market with the products expected by the consumers. The contemporary management of transport is feeling the brunt of an increasing level of social pressure. With the ever-increasing distance that goods and materials are transported, the time available for the realization of supplies is shrinking. In turn, the economic growth and the rising trade on a global scale leads to a dynamic development on the market of transport (Hajdul et al. 2015, p. 17).

Road management (*traffic management*) is the most significant logistics activity (Figure 3). The main activities in the sphere of road management are the decisions relating to the choice of sector, type and way of transportation (Wojewódzka-Król, Załoga 2016, pp. 627-628).

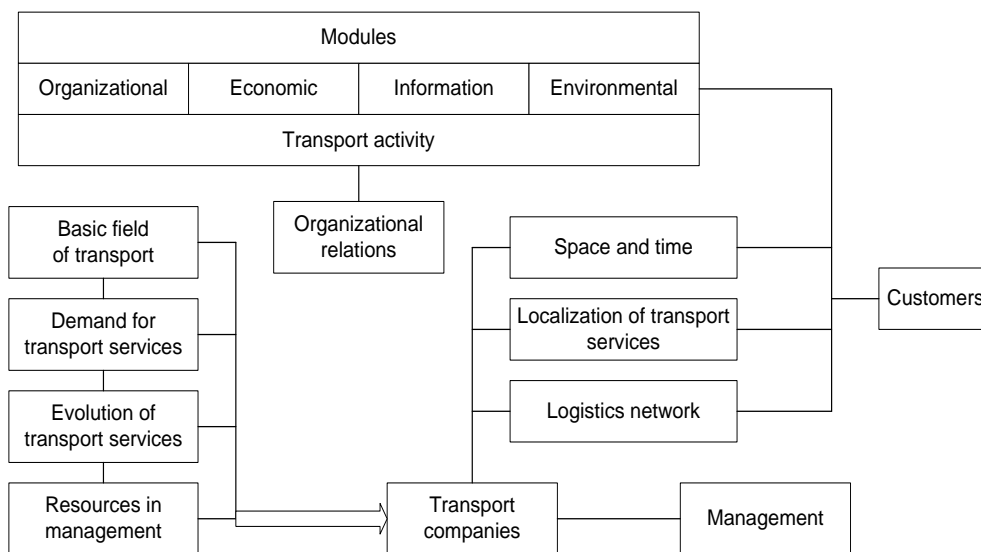


Figure 3. Module-relational structure in management of enterprises

Source: Self-analysis on the basis of (Hyard 2013, p. 223)

Managing transport is strictly associated with the analysis of profit and losses, namely “*trade-offs*”. The decision relating to the choice of a specified type of transport is also connected with the search for the appropriate relations between the cost and the level of logistics services (Kisperska-Moroń, Krzyżaniak 2009, p. 148). One of the more significant problems in road management is the indication of the benefits of the scope of the dimensions of transport. The prerequisites of its existence are the economies of scale which arise from the level of the costs formed over a long period. Apart from the detailed deliberations on this problem that is broadly outlined in subject-related literature, it is however worth indicating the interesting concept

relating the global and marginal costs to the transportation activities. The economies of scale associated with single-assortment production are possible to achieve when the flexibility (marginality) of the long-term production costs (AC) are formed below the level of unity, or when the marginal costs (MC) form above the average costs of production (AC). The magnitude of production is accepted to be at the level of Q . After simplifying the assumptions and with the increase of the production identified with value (transportation costs), which in this case the economies of scale with the flexibility of costs < 1 , is defined by an equation (Lupschen, Bahrami 2007, p. 366; Ben-Akira 2008; Biernacki 2013, pp. 18-25) (1):

$$MC(q) < AC(q) \quad (1)$$

and the subadditivity of the function of the costs of production is expressed by the following equation (2)

$$C(\sum_{i=1}^n q_i) < \sum_{i=1}^n C(q_i) \quad (2)$$

whereby q_i is part of the magnitude of the production of the same product – transportation services. The afore-mentioned analysis determines the decision-making level in the management of transport.

The magnitude of the load carried is most frequently applied in the choice of the type of transport, as well as the distance to be travelled. Other factors that are decisive in the choice of the type of transport are as follows: the features of the means of transport, the specifics of the product and its packing, safety of the delivery, as well as the time and speed of the delivery. The aforesaid characteristics are reflected in the models of business. The state of the delivery of the loads by car transport according to the type of load, as well as the type of body is illustrated in *Table 2*.

Table 2. Road vehicle transport in 2017

| Type of load | Transport for hire in thousands of tons | Commercial transport in thousands of tons |
|--|--|--|
| Total | 1 096 686 | 405 125 |
| Bulk cargo transport | 61 065 | 30 104 |
| Solid bulk materials | 478 226 | 217 727 |
| Large containers | 7 977 | 2 557 |
| Other containers | 34 | 126 |
| Loads on pallets | 269 777 | 64 930 |
| Connected loads | 18 851 | 4 739 |
| Self-propelled units (passenger vehicles) | 8 478 | 9 715 |
| Units without self-propulsion (trailers) | 360 | 194 |

Source: Self-analysis on the basis of statistical data in 2017, GUS (Central Statistics Office)

New challenges facing transport

Innovations in transport are implemented with the aim of satisfying institutional, commercial, individual and group needs. These innovations increase the efficiency and functionality of the transportation systems, reduce the demand on power, have an impact on the alternative forms of transport, the optimization of logistics and the fulfilment of the transportation needs of physical and legal entities (Trzmielak, Woźniakowski 2015, p. 29). Innovativeness in road transport may be perceived in terms of three aspects (*Figure 4*).

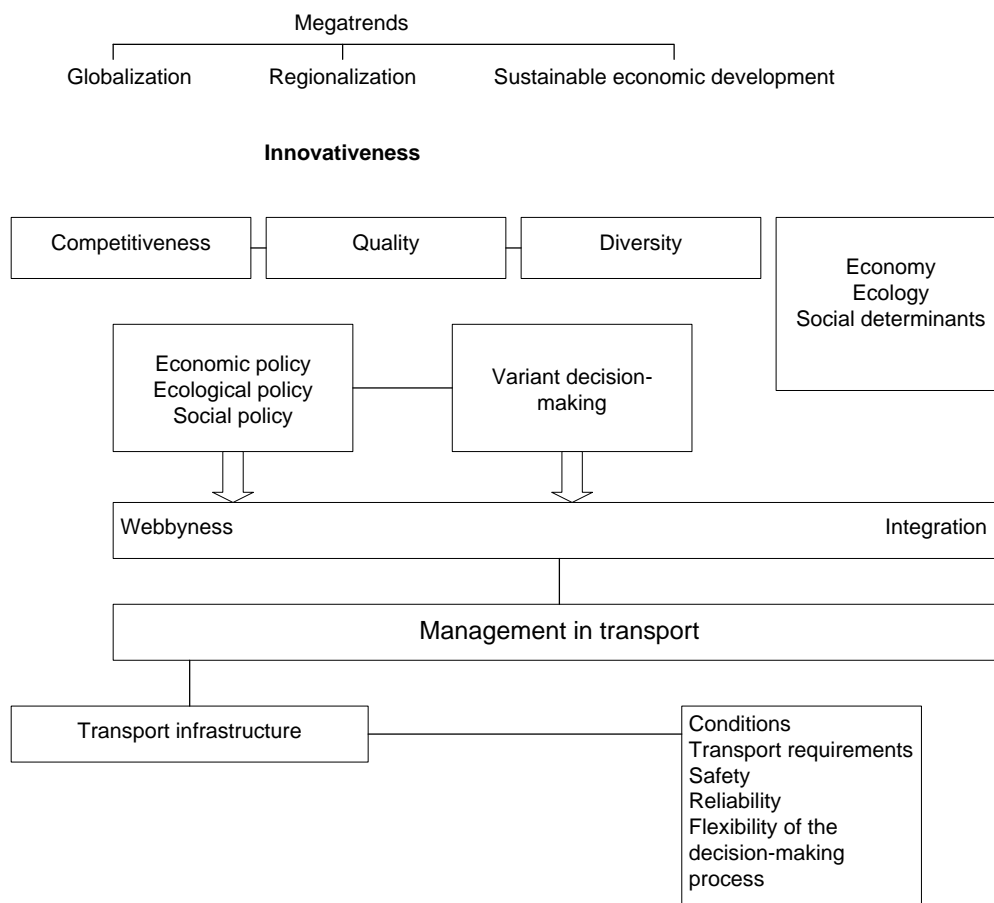


Figure 4. Integrative aspects of management in transport

Source: Self-analysis on the basis of (Kruse 2013, p. 67)

The economic transformation worldwide has caused the growth of trade between different parts of the globe. With relation to the growing demands posed to forwarders, the significance of the management of the particular branches of transport in the building of logistic chains is increasing. Various terms have been created for the definition of such cooperation, e.g. combined transport, as well as

intermodal and multimodal transport. We may assume that all of these terms relate to situations which during the course of the transportation process of a delivery various types of transport are availed of at different stages (Kozłowski, Sikorski 2013, p. 64).

The globalization and rapid development of IT society are forcing the increased tempo of the course of logistic processes. As a consequence, the implementation of innovative IT systems is essential. These systems are widely applied in, among other areas, such aspects of logistics as external and internal trade in goods, while also the use of handling services. In the management of the transportation processes, conducting the management of warehouses, while also an audit of the level of the warehouse stocks, records of warehouse stock turnover, the realization and preparation of transactions, servicing the handling processes, monitoring, controlling, streaming, while also the position of transportation deliveries.

The process of globalization is also perceived as the source of the growth in the mobility of society. Transport is the factor that conditions this mobility. Thanks to the increasingly fast means of transport, the distance between people is shortened, while the so-called compression of time and space overlap, as a result of which the world is perceived to be smaller and more accessible.

Regionalization is closely tied with globalization. A region as a structure works more efficiently than any state in terms of being able to cope with the process of management in conditions imposed by the processes of globalization. One of the conditions for equalling the disproportion in terms of regional development is that of the availability of transport. This is dependent on a multitude of factors which are as follows: ranging from the quality of the infrastructure, the frequency of the connections, the cost, possibilities of choice, as well as the preferences of the users (Wojewódzka-Król, Załoga 2016, pp. 13-26). Transport plays a significant role in determining economically justified geographical boundaries of the market. By increasing outlays on transport, we may have goods delivered from faraway distances that are cheaper than goods available within a closer proximity. In other words, we may carry out a substitution of outlays for goods for outlays on transport. A reduction in the costs of transport and consequently, a decrease in the outlays that are essential for transport thus facilitates having goods delivered from significantly further locations, which gradually leads to regionalization and globalization. The spatial mobility of the factors of production and the goods manufactured grow with the expansion of innovative activity. A fundamental role in this process is played by the improvement of transport and communication (Pietrzak, Roman 2014, p. 3643).

Improving the management of transport is facilitated by innovations. The consequence of economic growth is the increase in air pollution, emissions of noise, accidents, as well as the impact on the climate, in which transport has become responsible for environmental damage. Transport and transport infrastructure constantly interfere with the landscape of the terrain leading to violation of the value of the landscape, destruction of places that are particularly attractive from a historical and archeological viewpoint, as well as the destruction of flora and fauna by changes in the micro-climate caused by human activity (Wacek 2016, p. 253). Transport management must fulfil the conditions of environmental awareness while taking

account of economic optimality, social justification and political responsibility (Rucińska 2014, p. 288). Hence, the necessity of fulfilling the requirements of the sustainable growth of transport, while also the process of management of an innovative nature is taken into account. By way of example, solutions were proposed that involve joining a system and the process of storage with places allocated for storing waste. The aforesaid assumption has become the basis for the separation of the dependencies of linear demand for transport with relation to a load in terms of the aspect of reducing the number of the means of transport with the simultaneous increase in the mass loads transported. Likewise, the methodical potential for computer simulation of the number of locations and their dispersal in a system of communication roads (Wit 2016, p. 298).

The solutions of an innovative nature presented are one of the multitude of cases that confirm the importance of innovations in the management of road transport.

Conclusions

The deliberations shown illustrate that transport plays a significant role in the economic and social development of the country. Transport first and foremost ensures the correct functioning of the logistics systems of enterprises. Managing car transport is the fundamental condition for the fulfilment of the needs of consumers that move in time and space. On the one hand, management ensures mobility which is extraordinarily important for the quality of life of the travellers, while on the other hand, it facilitates economic growth and the development of new workplaces. Unfortunately, as statistics indicate, over the past few years there has been intensive growth in this area of transport, which in turn, has an unfavourable impact on the natural environment. Hence, innovative solutions are sought after that shall favour the development of enterprises with the simultaneous attention paid to sustainable transport.

References

1. Ben-Akira M. (2008), *Transportation Costs*, "Transportation System Analysis: Demanol & Economics", Massachusetts Institute of Technology, Fall.
2. Bentkowska-Senator K., Kordel Z., Waśkiewicz J. (2012), *Polski transport samochodowy. Rynek – Koszty – Ceny*, Instytut Transportu Samochodowego, Warszawa.
3. Biernacki D. (2013), *Korzyści zakresu działalności transportowej*, "Gospodarka Materiałowa i Logistyka", nr 8.
4. Brach J. (2012), *Internacjonalizacja polskich przedsiębiorstw międzynarodowego drogowego transportu ładunków*, Wydawnictwo Uniwersytetu Ekonomicznego, Wrocław.
5. Burnewicz J. (2010), *Perspektywa innowacyjna transportu i logistyki*, "Zeszyty Naukowe Uniwersytetu Szczecińskiego. Ekonomiczne Problemy Usług", nr 59.
6. Grigutsch M., Nywlt J., Bertsch S., Friese F., Nyhuis P. (2014), *Einfluss von Planungsparametern auf die Leistungsfähigkeit lines Arbeitssysteme*, "ZWF. Zeitschrift für Wirtschaftlichen Fabrikbetrieb", Vol. 109, Issue 10.
7. Hajdul M., Stajniak M., Foltyński M., Koliński A., Andrzejczyk P. (2015), *Organizacja i monitorowanie procesów transportowych*, Instytut Logistyki i Magazynowania, Poznań.
8. Hyard A. (2013), *Non-Technological Innovations for Sustainable Transport*, "Technological Forecasting & Social Change", No. 80.

9. Jacyna I. (2009), *Rola transportu w realizacji procesów logistycznych przedsiębiorstwa*, "Prace Naukowe Politechniki Warszawskiej. Transport", z. 69.
10. Kersten W., Skirde H., Lammers T. (2013), *Komplexitätscontrolling in Logistiksystemen*, "Controlling", Vol. 25, No. 2.
11. Kisperska-Moroń D., Krzyżaniak S. (2009), *Logistyka*, Instytut Logistyki i Magazynowania, Poznań.
12. Kozłowski R., Sikorski A. (red.) (2013), *Nowoczesne rozwiązania w logistyce*, Oficyna, Warszawa.
13. Kruse Ch. (2013), *Referenzmodellgestütztes Geschäftsprozeßmanagement: Ein Ansatz zur prozeßorientierten Gestaltung vertiebslogistischer Systeme*, Springer – Verlag, Wiesbaden.
14. Lupschen B., Bahrami K. (2007), *Cost Economies in Transportation Networks – Theory and Fast Moving Consumer Goods (FMCG). Case Study*, [in:] Delfman W., Klaas-Wissing T. (eds.), *Strategic Supply Chain Design. Theory Concepts and Applications*, Kolner Wissenschaftsverlag, Koln.
15. Neider J. (2008), *Transport międzynarodowy*, PWE, Warszawa.
16. Nowicka-Skowron M. (2000), *Efektywność systemów logistycznych*, PWE, Warszawa.
17. Pietrzak M., Roman M. (2014), *Rozwój transportu jako siła napędowa procesów globalizacji i regionalizacji międzynarodowej*, „Logistyka”, nr 4.
18. Rucińska D. (2014), *Promocja zrównoważonego rozwoju transportu – wybrane przykłady dobrych praktyk*, „Logistyka”, nr 2.
19. Schäfers P., Schmidt M. (2015), *Entwicklung eines integrativen logistik modells für die unternehmensinterne Lieferkette*, "ZWF. Zeitschrift für Wirtschaftlichen Fabrikbetrieb", Vol. 110, No. 12.
20. Trzmielak D., Woźniakowski M. (2015), *Innowacje w transporcie na przykładzie badań w sektorze transportowym*, "Zeszyty Naukowe Uniwersytetu Szczecińskiego. Ekologiczne Problemy Usług", nr 121. DOI:10.18276/epu.2015.121-02.
21. Urbani-Popiołek I. (red.) (2013), *Ekonomiczne i organizacyjne aspekty transportu*, Wydawnictwo Uczelniane Wyższej Szkoły Gospodarczej, Bydgoszcz.
22. Wacek P. (2016), *Zrównoważony rozwój transportu w Unii Europejskiej a rozwój społeczno-gospodarczy*, "Studia i Prace WNEiZ US", nr 44/3. DOI: 10.18276/sip.2016.44/3-20.
23. Wit B. (2016), *Ekologistyka w systemie zarządzania odpadami niebezpiecznymi*, TNOiK "Dom Organizatora", Toruń.
24. Wojewódzka-Król K., Załoga E. (2016), *Transport. Nowe wyzwanie*, Wydawnictwo Naukowe PWN, Warszawa.
25. Woźniak D., Kukielka L. (2011), *Niektóre aspekty logistyki transportu*, "Autobusy. Technika. Eksploatacja. Systemy Transportowe", nr 5.

INNOWACJE W ZARZĄDZANIU TRANSPORTEM DROGOWYM

Streszczenie: W dobie postępującej globalizacji konieczne jest dążenie do rozwoju i podejmowanie nowych wyzwań przez przedsiębiorstwa oraz ciągłe doskonalenie transportu drogowego. Celem tego artykułu jest wykazanie, że transport drogowy, który stanowi niezbędny element życia codziennego, jest jednym z najważniejszych czynników decydujących o wroście gospodarczym kraju. Niniejszy artykuł prezentuje empiryczne rozważania dotyczące funkcji i roli transportu w społeczeństwie jako całości, odnosząc się do istotnych kwestii transportu drogowego w łańcuchach logistycznych. Celem badań teoretycznych jest wskazanie nowych kierunków rozwoju logistyki i innowacji stosowanych w transporcie.

Słowa kluczowe: zarządzanie, transport, logistyka, innowacje